

## RESEARCH ARTICLE



# Using Q-methodology to understand stakeholder perspectives on a carnivore translocation

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## Abstract

1. Reversing global declines in predator populations is a major conservation objective, though people frequently come into conflict over carnivore conservation. As part of a national recovery programme for the pine marten *Martes martes*, a protected mesocarnivore in the UK, we used Q-methodology to understand the perspectives of residents living in an area in which a pine marten translocation project was planned.
2. In contrast to binary 'for or against' characterizations of debates surrounding such projects, we identified four perspectives with distinct priorities and concerns. A single perspective, 'Concerned Manager', opposed the translocation and marten recovery more generally, was apprehensive about impacts and favoured traditional predator management practices. Support was characterized by three perspectives: 'Environmental Protectionist', 'Natural Resource Steward' and 'Cautious Pragmatist'. Two explicitly supported the translocation but differed in their priorities: Environmental Protectionist framed marten restoration as an ethical imperative, whereas Natural Resource Steward emphasized ecological and economic benefits. Cautious Pragmatist supported marten recovery, but expressed ambivalence about the translocation.
3. We identified areas of divergence between the four perspectives, particularly surrounding risks posed by martens and need for predator control. We identified two areas of consensus among the four perspectives: support for a biodiverse environment and translocations as a means of achieving this (though this was contingent on the species), and agreement there would be economic and ecological benefits if martens controlled non-native grey squirrels *Sciurus carolinensis*.
4. We highlight that perspectives on this project were influenced by wider issues of wildlife management and conservation, particularly the impact and management of increasing populations of another mesocarnivore, the badger *Meles meles*. Negative experiences and perceptions of badgers were germane to the Concerned Manager perspective, and their fear that protected status would preclude marten

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population control. 'Rewilding' emerged as a divisive background issue, against which some participants evaluated the translocation.

5. In facilitating understanding of perspectives and establishing the contexts through which they were formed, we found that Q-methodology enabled us, as a team comprising conservation practitioners and researchers, to engage meaningfully with affected residents. We recommend the tool as a useful step in assessing social feasibility of conservation translocations.

#### KEYWORDS

*Martes martes*, pine marten, predator, public opinion, Q-methodology, reintroduction, rewilding, social feasibility, translocation

## 1 | INTRODUCTION

Direct and indirect competition for resources between humans and carnivores frequently leads to situations where their coexistence is strained, and predator management invariably takes place in complex socio-ecological contexts, in part as a result of actual and perceived risks to humans or their livelihoods. The deep-seated fear associated with an unfamiliar threat, and perceptions of exposure to harm, especially when imposed by an external agency, are important components of conflicts between people over wildlife (Inskip & Zimmermann, 2009; Naughton-Treves & Treves, 2005; Peterson, Birkhead, Leong, Peterson, & Peterson, 2010; Prokop, Fancovicova, & Kubiak, 2009; Skogen, Mauz, & Krangle, 2008; Starr, 1969). These may be exacerbated by lack of knowledge and experience of living alongside carnivores, a consequence of 'shifting baseline syndrome', whereby peoples' perceptions of what is natural and acceptable become biased towards disturbed ecosystems and a depauperate environment (Masashi & Gaston, 2018; Seddon & Heezink, 2013). This increasingly means acceptance of ecosystems with few, if any, resident carnivores as normal (Ripple et al., 2014; Vera, 2010). However, shifting baselines will also affect how increases in the abundance of species (e.g. from a historically low 'baseline') are perceived (Steen & Jachowski, 2013).

Carnivores are a major concern of conservation practitioners (Prugh et al., 2009; Ripple et al., 2014) and are popular candidates for conservation translocations (Seddon, Soorae, & Launay, 2005). Attitudes towards, and perceptions of, carnivores are affected by a number of socio-cultural and individual factors (Dickman, Marchini, & Manfredo, 2013), and translocation and reintroduction projects can become the focal point for the expression of existing grievances and clashes of ideology (Madden & McQuinn, 2014; O'Rourke, 2014; Wilson, 1997). The potential for negative human-wildlife interactions will always be greatest for those directly impacted by wildlife (Dickman, 2010) and local people who experience the costs, whether real or perceived, of living alongside wildlife are more likely to kill wild animals, whether legally or illegally (Woodroffe, Thirgood, & Rabinowitz, 2005). Ultimately, the best way to address conflict is to prevent it arising (Young et al., 2005) and in order to move towards

this, the perspectives of affected people, in all their subjective complexity, must be understood and taken into account. Given that the presence and behaviour of wild carnivores can affect people's well-being, security, livelihoods and future opportunities, conservation professionals proposing translocations arguably have an ethical and democratic obligation to understand and help address the risks (both demonstrable and perceived) to affected people (Chan et al., 2007).

The literature on perceptions of carnivore conservation and recovery has focussed mainly on large carnivores, which are usually framed as charismatic flagship species by conservationists in public discourses (Macdonald et al., 2015; Sergio, Newton, Marchesi, & Pedrini, 2006). Carnivore translocations are increasingly associated with the emergent 'rewilding' movement (Lorimer et al., 2015; Pettorelli et al., 2018). While a fluid and sometimes controversial concept, most rewilding initiatives share an aim of maintaining or increasing native biodiversity through the re-establishment of historical ecological communities and processes (Lorimer et al., 2015), which frequently involves the reintroduction or reinforcement of extirpated or threatened species. The re-establishment of large carnivores as apex predators is frequently a core ecological and ideological objective for rewilding initiatives but is also one of the most contentious issues associated with rewilding in public debates (Jørgensen, 2015; Svenning et al., 2016). Mesocarnivores, in contrast, are globally increasing in numbers and range and considered responsible for the decline of some protected species (Prugh et al., 2009; Ripple et al., 2014). Nevertheless, some species of mesocarnivore are themselves of conservation concern and are consequently the focus of conservation interventions (Seddon, Griffiths, Soorae, & Armstrong, 2014), and there are transferable lessons from the extensive body of research on large carnivore reintroductions. Like large carnivores, mesocarnivores may be perceived negatively as pests or 'vermin', due to real or perceived livestock losses (Roemer, Gompper, & Van Valkenburgh, 2009; Treves & Karanth, 2003), and the socio-cultural contexts and experiential factors that inform people's broader attitudes to carnivores are largely comparable, irrespective of size and trophic level (Dickman, 2010; Macdonald, Loveridge, & Rabinowitz, 2010).

Public opinion surveys are frequently used to describe the prevalence of different views on an issue (Barry & Proops, 1999), and the

act of undertaking the survey and reporting a selection of the results is typically taken as sound expression of democratic process. As such, public opinion surveys have been used to inform recovery efforts for several carnivore species, including European lynx *Lynx lynx* (Lescureux et al., 2011) and wolves *Canis lupus* (Treves, Naughton-Treves, & Shelley, 2013). Solely quantitative surveys have the advantage of being technically easy to respond to, can engage a large number of respondents, and can provide statistical generalization, but can be limiting in their restriction of a participant's responses (Eyvindson, Kangas, Hujala, & Leskinen, 2015). Qualitative methods allow participants to respond in a more diverse and individually meaningful way, and can therefore be more appropriate for understanding nuanced or minority views (Bamberger, 2000; Ockwell, 2008). Most desirable, perhaps, is a combination of quantitative and qualitative methodologies, that adopts multivariate means of describing perspectives and accounts for diversity across a spectrum of opinion. Q-methodology, developed as a means of characterizing human subjectivity, is one such methodology with increasingly recognized potential for conservation science (Addams & Proops, 2000; Webler, Danielson, & Tuler, 2009; Zabala, Sandbrook, & Mukherjee, 2018). Q-methodology is a form of pattern analysis, combining quantitative and qualitative elements (Stephenson, 1935), that typically involves a comparatively small number of respondents (<60: Watts & Stenner, 2012), employing a Factor Analysis of individual responses to explore patterns of commonality in perspectives across a topic, rather than generalizing from a sample to a larger population (Watts & Stenner, 2012). The resulting clusters of commonality might represent value positions, belief systems or mental models (McKeown & Thomas, 2013).

Q-methodology has found application in research on perceptions of ecosystem services (Eyvindson et al., 2015), resource and land management (Swedeen, 2006) and carnivore conservation (Chamberlain, Rutherford, & Gibeau, 2012). For an accessible entryway guide to Q-methodology, refer to Webler et al. (2009) and Watts and Stenner (2012), whilst Brown's (1993) primer provides excellent depth, drawing on the work of the underlying theory's founder William Stephenson. For a more targeted review of Q-methodology's potential applications in conservation research, refer to Zabala et al. (2018).

We conducted a Q-methodological study to understand local stakeholders' perspectives on a translocation of pine martens *Martes martes* to Wales. The pine marten is a mesocarnivore that lives throughout continental Europe (Mitchell-Jones et al., 1999). It was once widespread in Great Britain but woodland clearance and killing by gamekeepers led to severe decline during the 18th and 19th centuries (Langley & Yalden, 1977; Sainsbury et al., 2019). Recent genetic analyses indicated that English and Welsh populations were functionally extinct and comprised individuals that had escaped from captivity, or had been unofficially released (Jordan et al., 2012). This led to the conclusion that conservation translocations, whether these constituted a reintroduction or population reinforcement, were required to restore self-sustaining populations of pine martens to southern Britain (Jordan, 2011).

The Vincent Wildlife Trust, for which two of the study authors work, is leading pine marten recovery in the UK and in 2014 the Trust began work on a new species recovery programme, the aim of which is to restore viable populations of pine martens to parts of their former range in England and Wales. One project within this recovery programme was a conservation translocation, moving pine martens from Scotland to Wales. The Trust published a broad scale feasibility assessment of pine marten reinforcements (MacPherson, 2014), focusing on habitat assessment, site selection, ecological impacts and, to a lesser extent, public attitudes towards reinforcements. The latter involved a public opinion survey, in which 87.3% of 617 respondents expressed support for 'restocking' of pine martens in Wales, with substantive opposition expressed by those working in farming, gamekeeping and estate management, and based on fears for predation of resident wildlife, prioritizing the conservation of any residual, native pine martens and a lack of suitable habitat. The 2014 feasibility assessment specified that further, detailed consultation with stakeholders in potential release sites would be undertaken and would inform the final selection of release sites. This study therefore formed part of our process of engagement with affected residents ahead of the translocations. Translocations of pine martens to Wales were eventually initiated in 2015/2016 and continued for three seasons. Fifty-one individuals were translocated, released individuals prospered and have bred successfully and the species is now well established in Wales (McNicol et al., 2020).

It is essential to understand the perspectives of stakeholders in order to evaluate effectively the feasibility and desirability of conservation interventions, as well as to anticipate and manage potential conflicts, and Q-methodology is well-suited to this need (Mazur & Asah, 2013). Compared with other approaches, the methodology provides insight into more nuanced, sophisticated opinions (Kamal, Kocór, & Grodzinska-Jurczak, 2014), and can outline perspectives that might contribute to conflict development, or mitigation (Mazur & Asah, 2013; Young et al., 2016). The methodology is also sensitive to minority perspectives, which though low in frequency of occurrence, can have a disproportionately great impact on the outcome of conservation initiatives (Ockwell, 2008; O'Rourke, 2014; Redpath et al., 2013). Additionally, we hoped that this approach could facilitate a more substantive means of communication between members of our team, as conservation practitioners, and affected residents, and a greater degree of participation in early planning processes, compared to other potential approaches (Mazur & Asah, 2013; Ockwell, 2008; Watts & Stenner, 2012).

## 2 | METHODS

The study was conducted in the county of Ceredigion in Wales, centred around the villages of Pont Rhyd y Groes and Cwmystwyth, located along the river Ystwyth. The surrounding countryside is topographically varied and characterized by the east-west running valleys of Cwm Ystwyth and Cwm Rheidol. The valley sides are wooded with coniferous plantation or mixed broadleaf/conifer

woodland, while the land outside the valleys is predominantly unimproved and semi-improved grassland grazed by sheep, with large (for the area) coniferous plantations (>400 ha). This mosaic of habitats represents suitable habitat for pine martens in the UK (Caryl, 2008; MacPherson, 2014; McNicol et al., 2020).

Semi-structured interviews with nine residents of the study area were initially used to build a concourse of verbatim statements from which a subset, the Q-set, was derived for use in the wider study. The aim of these initial interviews was to identify, as fully as possible, the spectrum of viewpoints, within the community living in the proposed translocation area, towards the proposed pine marten reinforcement. These initial interviewees were required to have basic knowledge of pine martens, and of the translocation, and were selected based on their presence at one of three community consultation events held during the planning stages of the project. Interviewees were met at a place convenient for them. We conducted semi-structured interviews concerning pine martens, the proposed translocation and perceived positive and negative impacts and challenges. The interviews were orientated around four questions: (a) What do you think about pine martens? (b) What do you think of the proposal to translocate pine martens from Scotland to this area of Wales? (c) Tell me about any negative impacts you think the project might have? and (d) Tell me about anything positive that you think the project may deliver? Interviewees were given the freedom to discuss and expand upon issues they deemed relevant or connected. The conversations were recorded and transcribed.

A concourse of 95 verbatim statements was initially selected from the interview transcripts, with the aim of achieving full representation of the interviewees' responses. These were refined to an initial set of 40 statements, following consideration of the 95 statements by a group comprising the authors and Vincent Wildlife Trust project team who had collective experience of living and working in rural Welsh communities, expert knowledge of pine marten ecology in the UK and the issues associated with their conservation. Statements were selected by omission of those that were deemed ambiguous, had actually or potentially conflicting or contrasting interpretations or were duplications (Watts & Stenner, 2012; Webler et al., 2009). The remaining 40 statements were further reduced to the final Q-set of 30 statements (Table 1), following a pilot exercise in which the participants felt the process with 40 statements was too long. This was a necessary trade-off between capturing as much information in the statements as possible whilst not 'cognitively overloading' the participants (Zabala et al., 2018).

An independent sample of participants was recruited for the Q-methodological study. The majority (22) lived in the two villages of Pont Rhyd y Groes and Cwmystwyth. They were recruited using a combination of random and snowball sampling within the village by D.B. and H.D. (a native Welsh speaker). A further nine participants were purposively selected from a 15-km radius of the focal communities. These nine were targeted to fill in gaps in the spectrum of viewpoints (as identified by the authors and project team). This was due to failure of the initial sample of 22 to encompass hill farmers, farmers on large farms and gamekeepers living on estates outside

the two villages. Their selection was based on the recommendations of the initial interviewees, experience and local knowledge of the project team from previous community engagement work. The sample characterizes a rural Welsh community rather than a specifically targeted demographic and so a range of professions, affected to varying degrees by the translocation, were represented. Two recruits were excluded from analysis because of a lack of understanding of basic aspects of the proposal and so the sorts conducted by 29 participants were used in the analysis.

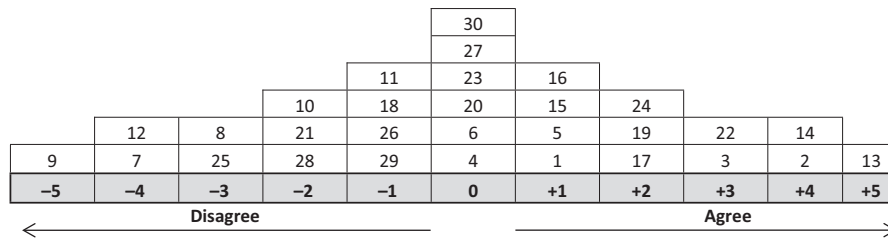
Participants sorted the 30 statements of the Q-set into a forced choice array, approximating a normal distribution, where there was one space for each statement, and where +5 was 'most agree', and -5, was 'most disagree' (Figure 1). The statements were numbered and produced bilingually (English and Welsh) on cards, allowing for participants to complete the sorts in their preferred language. Participants first sorted the statements into three piles; statements they agreed with, disagreed with and felt ambiguous about. They were then required to populate the array. After completing the sort, participants were given the opportunity to refine and shuffle the statements in the array until they were satisfied. At this stage, any additional information was noted down during informal post-sort discussions. This contextual information was used to supplement and enrich the data from the sorts.

Analysis was conducted using PQMETHOD (Schmolck, 2014). Four factors (each of which represents a distinct perspective) were selected and refined using automated varimax rotation which maximizes the amount of variance explained by as few factors as possible (Webler et al., 2009). Varimax rotation was used by the authors as a standardized practice in preference to manual rotation of the factors (Watts & Stenner, 2012). The selection criteria for factor extraction were based on visual interpretation of the scree plot, the Kaiser-Guttman criteria (eigenvalues exceeding 1) and relaxed interpretation of Humphrey's rule, where the factor was deemed significant if the cross-product of its two highest loadings exceeded the standard error for the correlation matrix (Watts & Stenner, 2012). The sorts that had a positive significant loading on each factor were identified from their factor loadings (the degree to which a sort was exemplified by a factor; Table 2). Absolute factor loadings of |0.47| or greater were deemed significant at  $p < 0.01$  (Brown, 1980).

Twenty-eight sorts significantly loaded onto the four factors. Sort 7 did not have significant loadings on any factor. Sort 5 significantly loaded positively on both Factors 1 and 2, and was therefore a confounding sort, but was retained in the analysis for both factors, as it was conducted by a participant who was the only commercial poultry producer (a form of livestock production that can be negatively impacted by pine martens). Factor 4 was a bi-polar factor and, for ease of interpretation, was rotated by 180° so that Sort 23 and Sort 29 (the two representative sorts in Factor 4) were positively associated. This reverse polarity can occur when more sorts load negatively on a factor (Watts & Stenner, 2012, pp. 133–139). Sorts 8, 10, 12 and 14 loaded negatively on Factor 4, indicating marked opposition; these negatively loading sorts were not used to derive the factor array for Factor 4, but Sorts 10 and 12 contributed to

**TABLE 1** Summary of a Q-method analysis of perspectives of local stakeholders towards a proposed pine marten translocation to Wales. A Q-set of 30 statements were sorted by 29 participants. The eigenvalues and percentage variance explained are provided for each of four significant factors. The statement scores for each factor represent a weighted average derived from the contributing sorts. Distinguishing statements for each factor are denoted with an asterisk

Statement	Factors				z scores			
	1	2	3	4	1	2	3	4
1 Pine martens are attractive animals	1	1	3	-3	0.5	0.5	1.1	-0.9
2 I like the idea of introducing a diversity of wildlife	4	3	5	0*	1.3	1.0	2.0	-0.2
3 I like the idea that I might be living in the vicinity of pine martens	3	1	3	-5*	1.2	0.6	1.1	-2.0
4 I think you will face a challenge from the farming community	0	0	-1	2	0.2	0.0	-0.4	0.7
5 There may be a positive effect to other wildlife	1	1	4	0*	0.7	0.6	1.7	0.2
6 We might gain the pine marten, but lose other wildlife	0	-2	-4	4	-0.5	-0.9	-1.5	1.8
7 The pine marten is vermin	-4	-4	-2	4	-1.9	-1.8	-0.7	1.8
8 This is humans messing with nature	-3	-1	-3	1	-1.1	-0.5	-1.2	0.6
9 I don't see any benefits to come from this project	-5*	-3*	2	-0	-2.0	-1.0	0.6	0.0
10 If I am losing lambs I will deal with it my own way	-2	-2	0	3	-1.0	-0.9	-0.1	1.1
11 When animals are overprotected you lose the balance of nature	-1	1*	-2	5*	-0.6	0.6	-0.7	1.8
12 If people are not allowed to keep them under control, there will be too many pine martens	-4	-2	0	2	-1.5	-0.9	-0.1	0.9
13 I think pine martens should be in Wales	5*	4	2	-1	1.7	1.0	0.8	-0.4
14 I don't think that humans should wipe them out	4	4	1	-1	1.5	1.7	0.5	-0.7
15 There will probably be more tourism in the area	1	0	1	-1	0.6	-0.2	0.4	-0.7
16 They might be shot by people who don't want them	1*	0	0	3*	0.5	-0.2	-0.2	1.0
17 It would be nice if like red kites they became a tourist attraction	2	0	1	-3	0.8	-0.0	0.5	-1.3
18 If it makes the application for a felling licence more complicated it will be an absolute nightmare	-1	2	-2	-1	-0.6	0.7	-0.9	-0.2
19 It is sad that people from my generation, and the generation before, have not had a chance to see them	2	2	0	-1	1.1	0.9	0.3	-0.2
20 People will not even know they are here	0	2*	-1	0	0.2	0.9	-0.3	0.0
21 There will be many farmers who will be sympathetic to the project	-2*	0	1	-4*	-0.6	0.5	0.3	-1.6
22 I think the translocation is a good step	3	3	0*	-4	1.2	1.0	0.2	-1.6
23 I think people would pay money to see them	0	-1	-1	-2	0.3	-0.6	-0.5	-0.9
24 If they can clear grey squirrels there will be economic and nature conservation benefits	2*	5	4	1*	0.2	2.1	1.5	0.2
25 One of my main concerns is TB, and bringing disease into the area	-3	-3	-5*	1	-1.0	-1.1	-2.0	0.3
26 I have reservations about introducing wild animals back into the countryside	-1	0	-3*	0	-0.6	-0.2	-1.3	-0.0
27 Pine martens were persecuted for a reason	0*	-4	-1	2	0.3	-1.5	-0.5	1.0
28 Pine martens have been known to take lambs	2	-5*	0	0	-0.7	-1.9	0.0	0.0
29 I am very concerned about poultry	-1	-1	-4*	1	-0.5	-0.4	-1.4	0.5
30 If I lose hens or lambs, it is difficult to prove what caused that loss	0	-1	2	-2	-0.2	-0.3	0.8	-0.9
Eigenvalue	6.4	4.6	3.8	3.5				
% explained variance	22	16	13	12				
Cumulative % explained variance	22	38	51	63				



**FIGURE 1** Example of a completed Q-sort from a study of affected residents' perspectives of a proposed translocation of pine martens to Wales. The numbers in each cell represent a single statement from the Q-set of 30 statements derived from interviews, listed in Table 1. The sort shown here is the exemplar factor array for Perspective 1 Environmental Protectionist

Sort (participant)	Factors Perspectives			
	1 Environmental Protectionist	2 Natural Resource Steward	3 Cautious Pragmatist	4 Concerned Manager
1	0.33	0.31	0.55*	-0.17
2	0.71*	0.21	0.26	-0.09
3	0.57*	0.36	0.43	-0.14
4	0.71*	0.32	0.34	-0.25
5	0.66*	0.53	0.31	-0.21
6	0.58*	0.34	0.05	-0.14
7	0.45	0.34	0.35	-0.46
8	0.46	0.02	0.30	-0.53 <sup>†</sup>
9	0.37	0.55*	0.29	-0.27
10	0.01	0.55*	-0.10	-0.54 <sup>†</sup>
11	0.71*	0.18	0.32	-0.33
12	0.55*	0.05	0.10	-0.71 <sup>†</sup>
13	0.24	0.64*	0.45	-0.22
14	0.38	0.42	0.37	-0.52 <sup>†</sup>
15	0.53*	0.19	0.15	-0.28
16	0.58*	0.27	0.21	-0.28
17	0.46	0.09	0.55*	-0.32
18	0.14	0.56*	0.07	-0.10
19	0.50*	0.41	0.32	-0.39
20	0.52*	0.42	0.16	-0.12
21	0.36	0.67*	0.29	-0.14
22	0.65*	0.35	0.03	-0.32
23	-0.22	-0.17	-0.21	0.60*
24	0.23	0.54*	0.22	0.11
25	0.17	0.19	0.82*	-0.20
26	0.39	0.65*	0.08	-0.31
27	0.17	0.19	0.82*	-0.20
28	0.46	0.63*	0.39	-0.24
29	-0.15	-0.11	-0.32	0.64*

**TABLE 2** Rotated factor loadings for 29 sorts in a Q-methodology study of affected residents' perspectives of a pine marten translocation in Wales. Sorts that significantly load positively on a factor are denoted with \* and negatively with <sup>†</sup>. The flagging process was automated and conducted in the PQMETHOD software package. Sort 7 did not have a significant loading onto any of the factors. Sorts 8, 10, 12 and 14 loaded significantly but negatively on Factor 4, and so were not included in deriving the array for Factor 4. Sort 5 was confounded it but was retained for both Factors 1 and 2 because the participant making this sort reared poultry commercially; the only participant to do so, and therefore was of particular interest given that pine marten presence potentially impacts the rearing of poultry

the arrays for the factors on which they loaded positively (Factors 2 and 1 respectively). Positive, significantly loading sorts were used to derive factor arrays, effectively a single 'ideal-typical' sort for

each factor. Each array was inspected and cross-referenced with the other arrays to identify the perspective-defining features, areas of consensus and points of disagreement. Material from the initial



interview transcripts and the post-sort discussions were referred to and incorporated into interpretation at this stage. Factor 4 was constructed from two positively loading sorts, which is the minimum required to constitute a factor (Webler et al., 2009). In this case, the authors made a judgement decision based on the percentage explained variance, the eigenvalue and our previous experience of a version of this Factor 4, both within the study community and more widely in rural discourse, and consistency with follow-up interviews.

The project team considered the ethical implications of participants potentially confiding illegal behaviour or personal enmity for other members of the community, and the potential for the research project to become a focal point of contentious discussion within the community. All participants were assured that they would not be identifiable in published work and that they had a right to withdraw at any time. Interviewees provided written, and Q Sort participants provided verbal, informed consent. The community was already aware of the proposed translocation, and of the practitioners' objective to facilitate inclusion through this study. It was therefore assumed that the potential for enmity was no greater than if the study had not taken place. No illegal behaviour was confided, explicated or evidenced in the opinions of any participant in this study. The study was approved by the University of Exeter College of Life and Environmental Sciences (Penryn) Ethics Committee.

### 3 | RESULTS

Twenty-nine participants sorted the 30 statements (Table S1) and four factors accounting for 63% of the variance were extracted (Table 1). These Factors 1–4 correspond to distinct perspectives, and from here onwards are referred to as 'Perspectives 1–4', described in more detail below. Each is given a summary title and a brief synopsis. Fuller interpretations are then provided, along with their contributing Sorts 1–29. Bold numbers in brackets represent the statement number, followed by its corresponding score in the factor array (Table 1). Typical quotations from the initial nine interviews from which the statements were derived, identified by the interviewee occupation, and from the post-sort discussions with participants, identified by the number of the Q-sort they provided, are included in the interpretations.

#### 3.1 | Perspective 1: Environmental Protectionist

Twelve sorts loaded significantly onto Perspective 1 (Sorts 2, 3, 4, 5, 6, 11, 12, 15, 16, 19, 20, 22), and were undertaken by seven female and five male participants, working as a healthcare professional, full time parent (2), receptionist, small holders (2), delivery driver, carer, cleaner, hospitality, tree surgeon and unemployed.

Strong agreement with potential benefits to come from the project was a significant distinguishing statement for Perspective 1 (9, –5). The pine marten was an attractive animal (1, +1) that it would be nice to have living locally (3, +3); *'It's a native species so we have*

*a duty to protect it'* (Participant 6). The pine marten's return would contribute to diversity within the local environment (2, +4), which was desirable, but there was uncertainty over whether it might lead to the loss of some wildlife (6, 0). Reintroducing animals was favourable (26, –1), and the pine marten translocation was a good step (22, +3); the idea that the translocation is 'humans messing with nature' was rejected (8, –3). It was agreed that a negative impact on grey squirrels *Sciurus carolinensis* (an invasive, non-native species in the UK) was positive (24, +2), and that there could be consequent positive impacts on other wildlife from the removal of a competitive pest species (5, +1). It was sad that current and previous generations had missed out on the chance to experience them (19, +2); *'It is sad, I think, for many British people of my generation, and indeed many generations before, that they would have had no chance to see them'* (Interview, Nature reserve manager). This reflected general comments made by contributors during the post-sort discussion, that humans had had a very negative impact on the natural world and had a responsibility to redress the damage; *'We've already ruined everything. It's nice to put something back'* (Participant 5). There was strong rejection that the pine marten population would need control to stop them becoming too numerous (12, –4), and 'overprotection' for species was not seen as potentially upsetting the balance of nature (11, –1). It was not thought that there would be much sympathy for the project within the farming community, which was a distinguishing and significant feature of Perspective 1 (21, –2). The farming community might not challenge the translocation (4, 0); but people that did not want them around, might shoot them illegally (16, +1); *'There are always some people who want to shoot things'* (Interview, Conservation professional). Two participants (5 and 6) explained during the post-sort discussion that they thought farmers were the primary cause of historic and current biodiversity loss, and illegally persecuted predators.

#### 3.2 | Perspective 2: Natural Resource Steward

Nine sorts loaded significantly onto Perspective 2 (Sorts 5, 9, 10, 13, 18, 21, 24, 26, 28), comprising one female and eight male participants, working as small holders (2), retail worker, forestry worker, retired businessman, civil servant, retired sheep farmer, nature reserve manager and a retired healthcare professional.

The strongest theme in Perspective 2 was a perception of potential ecological and economic benefits occurring as a result of a negative impact of pine martens on grey squirrels (24, +5) and a consequent reduction in tree damage; *'The bigger picture is that there could be a major benefit to forest management'* (Interview, Land agent). It was perceived that there would be a positive impact on other wildlife from reduced grey squirrel abundance (5, +1), and that there would not be loss of wildlife as a result of pine marten presence (6, –2). It was agreed that it would be an 'absolute nightmare' if pine martens made applying for a felling licence more challenging (18, +2). It was strongly rejected that pine martens have been known to take lambs, which was significant and distinguishing for Perspective 2 (28, –5); *'I can't see a problem. Once a lamb is a*

*week old it will too big for a pine marten*' (Participant 26). It was also rejected that martens were persecuted for a reason (27, -4), and that people would potentially take the law into their own hands in response to predation of livestock (10, -2). It was thought sad that current and previous generations had missed out on the chance to see them (19, +2), and their return to Wales via the translocation was supported (22, +3). It was strongly agreed that they should be in Wales (13, +4), and favourable that they would live in the local vicinity (3, +1). It was agreed that people would not know they were present, which was a distinguishing statement (20, +2), and there was a neutral perception over whether they would increase tourism (15, 0); people would not be willing to pay to try and see them (23, -1). There was weak agreement that when animals are overprotected, the balance of nature is lost, which was significant and distinguishing (11, +1); *'We are a nation of land managers, and that applies to wildlife as well'* (Interview, Nature reserve manager). Perspective 2 was influenced by views of badgers *Meles meles*, which was acknowledged in Sort 26, provided by a nature reserve manager, who stated that, despite not wishing to rescind their protection, they felt obliged to acknowledge that badgers had a negative impact on ground nesting birds within the nature reserve. There was, however, no concern that without population control there will be too many pine martens (12, -2).

### 3.3 | Perspective 3: Cautious Pragmatist

Four sorts loaded significantly onto Perspective 3 (Sorts 1, 17, 25, 27), undertaken by four female participants, working as a mental health worker, retired healthcare professional, sheep farmer and a businesswoman.

The desire for introducing/experiencing a diversity of wildlife in the countryside was a strong theme in Perspective 3 (2, +5), and the potentially negative impact the pine marten might have on grey squirrels was seen as very positive (24, +4). It was strongly agreed that the pine martens will be beneficial to other wildlife by reducing the abundance of grey squirrels (5, +4), and that wildlife would not be lost as a result of their being translocated (6, -4). It was thought that pine martens should be in Wales (13, +2), but there were reservations over whether the translocation was a good step, which was significant and distinguishing for Perspective 3 (22, 0). Post-sort discussion highlighted that this was, in part, due to doubts over future unforeseen effects and being able to achieve an equitable solution for any negative impacts; *'It's fine now when there are not too many, but what happens when they become more common?'* (Participant 25). This was linked to concerns that project staff would only be present for a limited amount of time, and that there would be no-one on hand to address any issues that arose in the future; *'If we're going to do conservation, we need somebody who is knowledgeable, realistic, and local'* (Interview, Smallholder). There was also concern that despite the initially well-meant objectives of conservationists, there was potential for unintended consequences in the future. A sheep farmer recounted when families were relocated from a neighbouring

valley to make way for government-led afforestation, *'The Forestry Commission had good intentions. But we lost flower meadows, good grazing ground, and communities were destroyed when farmers were evicted for planting'* (Participant 25). Wildlife reintroductions were viewed positively (26, -3) and it was agreed that it would be nice to live in the vicinity of pine martens (3, +3). There was some concern over the threat to livestock, though not for poultry (29, -4); the pine marten was not seen as vermin (7, -2). There was uncertainty over whether pine martens have been known to kill lambs (28, 0), and also whether the martens would be dealt with 'in my own way' if there were problems concerning lambs (10, 0). There was weak agreement that some farmers will be sympathetic to the project (21, +1), and it was thought unlikely that the project would face challenges from the farming community (4, -1).

### 3.4 | Perspective 4: Concerned Manager

Two sorts loaded significantly positively onto Perspective 4 (Sorts 23, 29), both undertaken by male participants, working as a farmer/gamekeeper and a sheep farmer, who was a member of a game-bird shooting syndicate. Four further sorts loaded significantly, but negatively, onto Perspective 4 (Sorts 8, 10, 12, 14), indicating that Perspective 4 was characterized as much by disagreement as by agreement.

The pine marten was perceived as vermin (7, +4), and the translocation was not considered a good step (22, -4). Pine martens were not wanted in the local vicinity, which was a non-significant distinguishing statement (3, -5), and there was weak disagreement that they should be in Wales at all (13, -1). It was stated that pine martens were historically persecuted for a reason (27, +2); *'Pine martens must have been kept down for a reason'* (Interview, Sheep farmer). There was ambiguity over whether any good will come from the project (9, 0). It was not thought there would be an increase in tourism (15, -1) and such an increase was not considered desirable, when compared to the example of the red kite, a major local tourism draw (17, -3). It was thought that there would be too many pine martens if they were not controlled (12, +2), and 'overprotection' of species was seen as negatively affecting the natural balance, which was a distinguishing concern (11, +5). During interviews and post-sort discussions, participants referred to badgers, and the perception that they were overabundant and overprotected; *'There are badgers on the mountain now, where they've never been before'* (Participant 23) and *'Badgers have gone out of control because they've been overprotected'* (Interview, Sheep farmer). It was agreed that it would be positive if the martens were to negatively impact upon the grey squirrel population (24, +1), but the stance on whether the marten, overall, would benefit other wildlife was neutral (5, 0). It was strongly agreed that some wildlife might be lost as a consequence of bringing back the pine marten (6, +4); *'The wood pigeon is coming back strong from nothing. Something like this is going to have the nests of them. What you're gaining in one way you're losing in the other, and personally, I'd rather have the pigeons'* (Participant 29). The idea of introducing diversity



into the environment was perceived neutrally, which was a distinguishing feature (2, 0), as was their stance on introducing wildlife back into the countryside in general (26, 0). It was thought that the pine marten project would face a strong challenge from the farming community (4, +2), and there was strong disagreement that there might be sympathetic farmers, which was both distinguishing and significant (21, -4). It was implied that direct action would be taken if livestock were lost (10, +3), and that the martens might be shot by people who did not want them, which was distinguishing but not significant (16, +3). Disease transmission, particularly bovine tuberculosis, was a concern (25, +1). Predation of poultry was a concern (29, +1), though this also pertained to reared pheasants *Phasianus colchicus*, as both participants with sorts loading positively on Perspective 4 reared pheasants for shooting. One participant echoed the views of a sheep farmer who had contributed to the interview stage, expressing concern about rewilding, where the pine marten translocation was perceived as the '*thin end of the wedge*', paving the way for larger predators and the beaver *Castor fiber*, while the other participant lamented the loss of ground nesting birds, implying that the pine marten project would undermine the efforts he had made to protect them, stating '*it's farmers who look after the countryside*'.

## 4 | DISCUSSION

We have identified a diverse set of perspectives within the community of residents most directly affected by a proposed carnivore translocation. We identified a perspective of clear opposition to the project (Perspective 4 Concerned Manager), based on a broad-based concern about predators and predation, but then identified the three distinct Perspectives 1–3 that were broadly supportive of pine marten recovery, one of which (Perspective 3 Cautious Pragmatist) was more qualified and contingent. The Q-methodological study achieved a rich, contextualized understanding of locally relevant perspectives of the pine marten, its translocation and the prospect of living alongside them. This diversity of perspectives contrasts markedly with the binary 'for or against' arguments, by which public debate on such proposals is typically characterized.

As capturing the full range of perspectives on this issue was key to our study, we followed Watts and Stenner's (2012) strategic sampling approach, recruiting 29 participants with the aim of maximizing diversity in responses. Once we had reduced our set of statements from 40 to 30 for ease of use, the ratio of statements to participants approached 1:1, which some Q-methodologists caution against on statistical grounds (Webler et al., 2009). However, there is a trade-off to be made in Q-methodological studies between this and having too few participants to effectively capture and describe the full range of perspectives (Webler et al., 2009). As the four perspectives we identified are distinctive, parsimonious and consistent with the statements of participants in follow-up interviews, we do not believe our statement to participant ratio affects the validity of our findings. One limitation of using Q-methodology is, however, that it is not possible (or necessarily desirable) to quantify the prevalence

of support/opposition, or determine how different perspectives are distributed among a broader population (Ten Klooster, Visser, & de Jong, 2008). We deemed this acceptable given the richness of information produced and the exploratory nature of the study. This does mean, however, that we cannot determine which of the Perspectives 1–4 constitute majority or minority views; for example, it is possible that the Perspective 4 Concerned Manager, though a minority view in our study, characterized by profound opposition to pine marten recovery, would be more widespread in a broader sample.

Participants associated with Perspective 4 Concerned Manager identified themselves as custodians of nature—'*who look after the countryside*'—and believed that their objectives were likely to be undermined by protecting predators that historically would have been managed, or manageable. The livelihoods of the participants associated with Perspective 4 Concerned Manager were directly derived from the environment into which the pine martens were to be translocated, and were willing to take action against them if their livelihoods were threatened. This is a key area of concern, for pine marten conservation, given that relatively few instances of human-induced mortality could undermine population establishment (Treves et al., 2017). 'Shifting baseline syndrome' appeared to play a role in framing the Concerned Manager perspective of predators, though it related to comparisons with increasing abundance of badgers rather than any broader 'generational amnesia' associated with wildlife decline over time (Steen & Jachowski, 2013). The abundance of badgers in England and Wales has increased markedly since the 1980s (Judge, Wilson, Macarthur, McDonald, & Delahay, 2017), and the badger population within the study area was described by participants associated with Perspective 4 Concerned Manager as being 'out of control', colonizing areas in which they had never before experienced them. Badgers provided a reference point by which these participants assessed the proposition of pine marten recovery, including concern that pine martens might introduce and/or be a vector for bovine tuberculosis—a highly emotive issue associated with badgers in the UK (Keenan, Saunders, Price, Hinchliffe, & McDonald, 2020).

Perspective 4 Concerned Manager is similar to the 'nature controller' perspective identified in a study of views on rewilding in Switzerland (Bauer, Wallner, & Hunziker, 2009) and has repeatedly been articulated in conservation conflicts in the UK and Ireland. It also is the most divergent from the Perspectives 1–3 identified in this study, indicating potential for conflict among stakeholders, and so it is crucial that conservation professionals understand and engage with Perspective 4. During a white-tailed eagle *Haliaeetus albicilla* reintroduction in Ireland, conservationists failed to recognize or respond to a similar perspective; upland farmers who opposed the eagle project felt marginalized and frustrated by the lack of any meaningful consultation prior to the eagle releases or efforts to mitigate potential impacts, and what initially began as vocal opposition, escalated into the poisoning of eagles (O'Rourke, 2014). In her conclusions, O'Rourke (2014, p. 136) stated that the farmers' 'ultimate gripe with the sea eagle project was that they saw nothing in it for themselves, only the fear of more land designations'. Similarly,

failure to effectively engage or accommodate the concerns of sheep farming communities in relation to a proposed reintroduction of European lynx to Kielder Forest in Northern England, led partly to the UK Government's public rejection of proposals (Gove, 2018).

In comparison with the single oppositional Perspective 4, broad support for pine marten recovery involves a spectrum characterized by Perspectives 1–3. These were motivated by distinct objectives and concerns and varied in their level of enthusiasm for both pine marten conservation in general and restoration by translocation as a goal in its own right.

For each of the Perspectives 1–3, the pine marten was a welcome addition to the local fauna, which would be a positive contribution to biodiversity. None expressed concern about pine marten predation of wildlife and poultry, despite martens being historically associated with predation of poultry and gamebirds in the UK (Reynolds & Tapper, 1996) and with conflict in Scotland where they are implicated in the decline of the protected capercaillie *Tetrao urogallus* (Young et al., 2016). 'Shifting baseline syndrome', might again inform these perspectives, though this time in the form of generational amnesia (Papworth, Rist, Coad, & Milner-Gulland, 2009), whereby expectations of pine marten impact are based on existing, low population sizes rather than greater historical abundances and (more fraught) interactions. Several participants significantly aligned both positively with perspectives supportive of the reintroduction and negatively with the opposing Concerned Manager perspective, and disagreement about the potential risks posed by pine martens is one clear source of tension between the Concerned Manager and other perspectives. Negative attitudes towards wolves within the species' range have been shown to increase over time (Dressel, Sandström, & Erickson, 2014; Treves et al., 2013), and it is possible that initial enthusiasm for pine marten recovery may be tempered if there are negative impacts on livestock, popular wild species or species of conservation concern in the future. Consequently, as pine martens recover, individuals currently expressing Natural Resource Steward or Cautious Pragmatist perspectives might shift towards that of a Concerned Manager. Nevertheless, significant differences among perspectives about the best way to manage predator impacts indicate continued potential for conflict among stakeholders in relation to the suitability of lethal predator control.

For Perspective 1 Environmental Protectionist, wildlife conservation is a matter of principle and a top priority. From Perspective 1, which is aligned with a romantic 'wilderness' image of European landscapes (Buijs, Pedrolí, & Luginbühl, 2006), there is an ethical imperative for ecological restoration wherever possible, and natural environments should be allowed to flourish for future generations, with minimal human intervention. A similar perspective was expressed by birdwatchers and hikers towards biodiversity in the Cairngorms, Scotland (Fischer & Young, 2007) and by 'nature lovers' towards rewilding processes in Switzerland (Bauer et al., 2009).

Perspective 2 Natural Resource Steward is more practical in its focus, and is comparable to Bauer et al.'s (2009) 'nature-connected users', to the views of farmers and foresters towards biodiversity in the Cairngorms (Fischer & Young, 2007) and to a 'stewardship'

mode of killing, among those involved in grey squirrel management (Crowley, Hinchliffe, & McDonald, 2018). Participants associated with Perspective 2 supported the translocation but believed that some conservation objectives required management. In this respect, Perspective 2 Natural Resource Steward aligns with that of Perspective 4 Concerned Manager in somewhat agreeing that increasing badger abundance had negatively impacted some bird species, though Perspective 2 Natural Resource Steward did not necessarily endorse population control. Perspective 2 Natural Resource Steward support for translocation was strongly driven by an expectation of increased opportunity to grow more commercially valuable hardwoods if pine martens were to suppress the invasive non-native grey squirrel, which is associated with significant tree damage in the UK and Ireland (Sheehy & Lawton, 2014). This Perspective 2 includes concerns, however, that pine marten presence might restrict forest management, highlighting the trade-off between the dual objectives of biodiversity conservation and natural resource management. This trade-off has the potential to cause tension with Perspective 1 Environmental Protectionist, which focuses on wildlife conservation as the top priority, not a compromise.

Perspective 3 Cautious Pragmatist represents the most muted support for the pine marten translocation. Negative experience of environmental schemes might inform Perspective 3, making support for particular projects contingent on trust, accountability and equitable solutions to any future negative impacts. As noted above, there is potential for Perspective 3 Cautious Pragmatist to shift towards or sympathize with Perspective 4 Concerned Manager, if negative impacts on livestock arise, or if they perceive social injustice as a consequence of the intervention. However, Perspective 3 overlapped with all three of the others, meaning that those expressing Perspective 3 Cautious Pragmatist may be in a position to act as diplomats and mediators within the affected community.

Despite difference in priorities, most clearly apparent in the divisions between Perspective 1 Environmental Protectionist and Perspective 4 Concerned Manager, we identified consensus across all Perspectives 1–4 in two areas: First, there was a general desire to introduce a diversity of wildlife to the local environment, which was most enthusiastically endorsed by Perspective 1 Environmental Protectionist and Perspective 3 Cautious Pragmatist. Biodiversity was perceived as positive, and efforts to protect or increase it were supported. Perspective 4 Concerned Manager support for conservation translocations was, however, contingent on the species involved; predators were not perceived as desirable biodiversity, but participants expressing this Perspective 4 supported interventions to increase the abundance of non-predatory species, such as black grouse *Lyrurus tetrix* and Eurasian curlew *Numenius arquata* (Participant 29). Second, there was unanimous agreement that if pine martens had a negative impact on the invasive grey squirrel there would be economic and ecological benefits, as a result of reducing the squirrels' negative impacts on tree health, hardwood timber production and native wildlife. The prominence of this area of consensus was largely attributable to recent research suggesting that in Ireland and Scotland, the natural recovery of pine martens

had driven a population crash in grey squirrels, and that subsequently the native red squirrel *Sciurus vulgaris* had recolonized much of its former range (Sheehy & Lawton, 2014; Sheehy, Sutherland, O'Reilly, & Lambin, 2018). This research has led to a proliferation of media coverage in which the pine marten has been presented as a panacea for the UK's grey squirrel problems and a saviour of the red squirrel. Such a compelling narrative in the media has great power to influence public perceptions (Hodgson, Redpath, Fischer, & Young, 2018). Conservation practitioners will need to treat this with caution. As tempting as it might be to promote the benefits arising from the pine marten–grey squirrel predatory relationship, as it appears to represent a 'holy grail' win-win for conservationists (Rosenzweig, 2003), and provides a compelling narrative to support native predator recovery (Arts, Fischer, & van der Wal, 2012), if the effect is not locally apparent and people's expectations are not met, it could damage the reputation of the project and break down trust between stakeholders and practitioners (O'Rourke, 2014).

Aside from the specifics of this translocation of pine martens to this location in Wales, we emphasize the role of wider issues influencing stakeholder perspectives. As a species that was effectively locally extinct for decades, few of our study participants felt strongly about pine martens per se. Rather they expressed views about predators and predation in general, or their potential ecosystem function as controllers of damaging pests. Such conservation interventions, perhaps particularly species restoration initiatives, will rarely be supported or opposed by those affected as points of principle, or in isolation from their broader experience and interests. Indeed, these projects may become focal points for expression of wider, sometimes pre-existing, discord (Wilson, 1997). Rewilding, an increasingly popular but contentious topic in the UK (Hayward et al., 2019; Lorimer et al., 2015), is a case in point. Wider shifts, in Europe and elsewhere, in dominant societal narratives and value systems relating to natural environments and their management (Manfredo et al., 2017) are perhaps best exemplified by (in the 20th century) the increased designation of land for conservation and, more recently, the growing popularity of rewilding. The rewilding concept is already divisive within the area of the proposed pine marten translocation (Fenwick, 2013; Wynne-Jones, Strouts, & Holmes, 2018), particularly among sheep farmers, some of whom feel vilified by (a particular form of) pro-environmental public and media discourse for their purported role in biodiversity decline (Monbiot, 2014). Participants expressing Perspective 4 Concerned Manager in this study regarded the pine marten translocation as being 'the thin end of the wedge' and a starting point for scaled up predator introductions associated with rewilding, and thought that if wildlife disappeared from farmland as a result of pine marten predation, 'it's farmers who will get the blame' (Interview, Sheep farmer). The subtle distinction between translocations for species conservation versus translocations for rewilding (Seddon et al., 2014) was not made by our participants. Perspective 1 Environmental Protectionist aligned with one rewilding ethos of a moral imperative to recover nature and to support reintroductions, whilst expressing criticism of farming

for its perceived role in biodiversity decline and a sense that some farmers illegally persecuted predators. Rewilding has become an emotive, ideologically charged background against which wildlife translocations take place in the UK, and if not sensitively approached, pine marten translocations could become a focal point for conflict between those perceiving and supporting such measures through a rewilding framing, and those who perceive it as representative of an existential threat (Brook, 2018).

The influence of these broader disputes can hamper attempts to reconcile discordant views, risking the entrenchment of stakeholder positions and development of more intractable conflict scenarios between people over wildlife, situations which currently characterize arguably the two most high-profile conservation conflicts in the UK: hen harrier *Circus cyaneus* conservation and grouse shooting in the uplands and badger culling for bovine tuberculosis control (Price, Saunders, Hinchliffe, & McDonald, 2017; Thirgood & Redpath, 2008). The influence of the latter debate on stakeholder perceptions of meso-carnivores was particularly evident in this study, highlighting the need for conservation practitioners focused on particular projects to remain cognisant of the wider socio-political contexts they are working in.

Conservation professionals are increasingly, and rightly, challenged to consider the social feasibility and impacts of their planned interventions (Bennett, 2016; Bennett et al., 2017; Crowley, Hinchliffe, & McDonald, 2017), and Q-methodology offers an effective tool to achieve better understanding of diverse stakeholder perspectives. Though conservation professionals have a reasonably comprehensive toolkit for practically mitigating predator impacts, investment in effort to understand stakeholder perspectives, and thereby to start to address social dimensions of conflict, remains inadequate (Macdonald et al., 2010). As practitioners leading a species recovery programme, and in evaluating and preparing for this conservation translocation, we found Q-methodology to be an accessible, productive and effective approach to understanding the range of perspectives held by stakeholders, and one that could readily be applied in other comparable settings. It is unrealistic to expect unanimous support, or to simply align majority scores in questionnaires with democratic legitimacy, for any conservation intervention. By identifying diverse stakeholder perspectives and acknowledging the background and legitimacy of each, practitioners can reduce the potential for affected people to feel marginalized, promote inclusivity and encourage a more democratic approach to conservation (Pooley et al., 2017; Redpath et al., 2013).

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## CONFLICT OF INTEREST

Sarah Crowley is an Associate Editor for *People and Nature* but was not involved in the peer review or decision-making process for this manuscript. The authors declare no other competing interests.

## AUTHORS' CONTRIBUTIONS

D.B., J.M. and R.A.M. conceived the study; D.B. and H.D. collected the data; D.B. conducted analysis and drafted the manuscript. All authors contributed critically to drafts and gave final approval for publication.

## DATA AVAILABILITY STATEMENT

All data are available in the manuscript and Supporting Information (Table S1).

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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